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(54) Filter leaf

(57) A filter leaf has two flat faces, at least one of which is covered by a filter cloth and comprises a peripheral frame 1, a support fitting 4, a fitting 7 by which the frame may be attached to a vibrating plate 6, and a fitting 5 by which filtrate may be removed from within the frame. Parts of all the fittings are removably secured to the frame after positioning of filter cloth over the frame. The filter cloth may be supported within the frame by woven or welded plastics mesh 9 held in position by clips 20. The cloth may be in the form of an enclosing bag or two flat sections with peripheral cuffs and drawstrings.

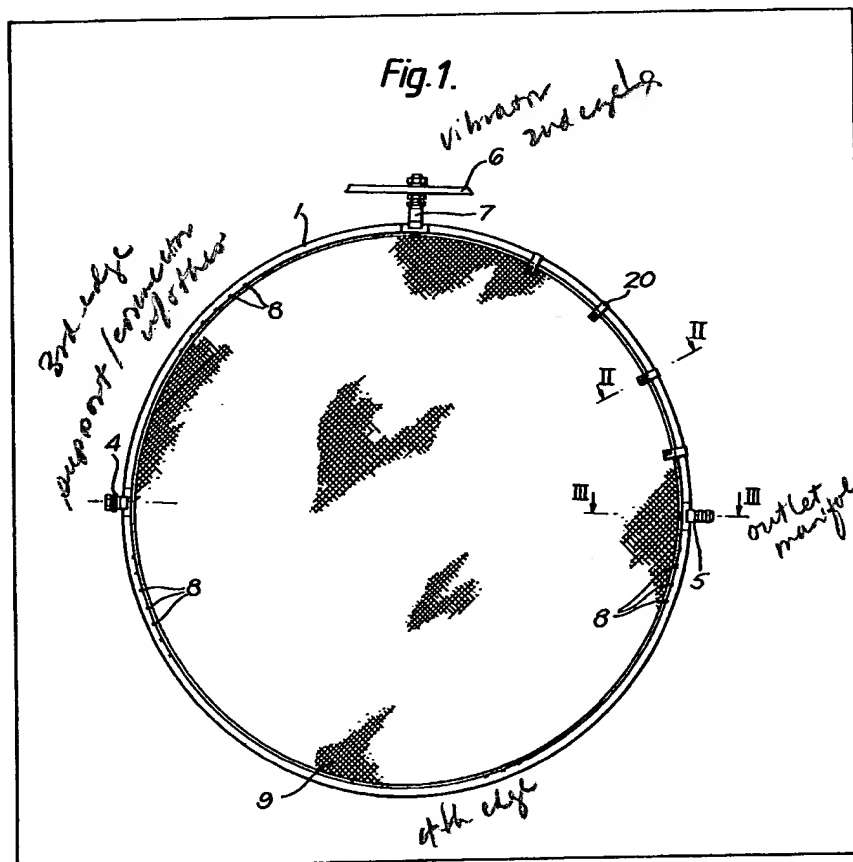




Fig.2.

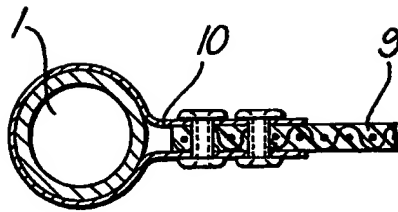
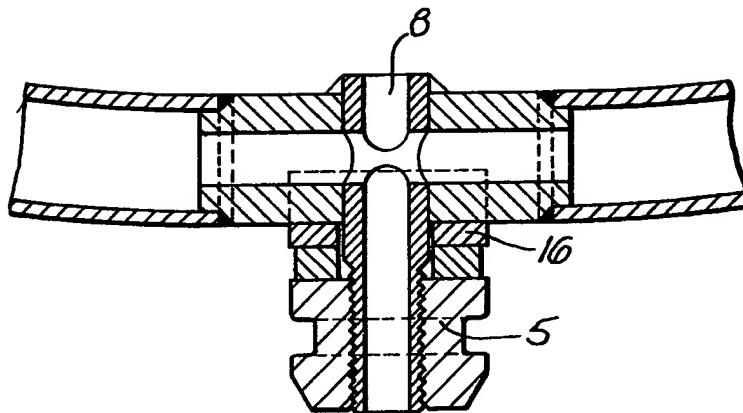


Fig.3.



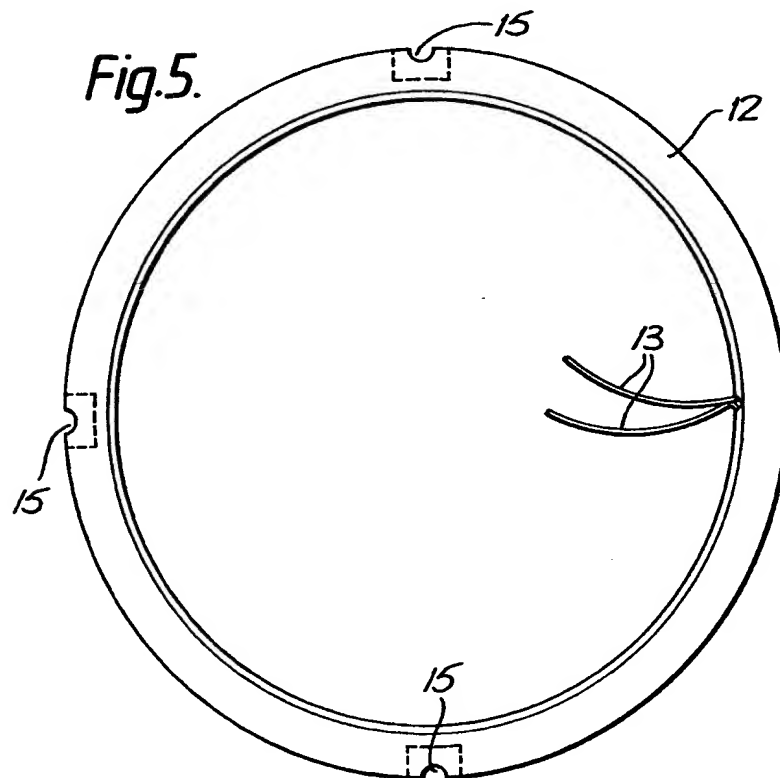
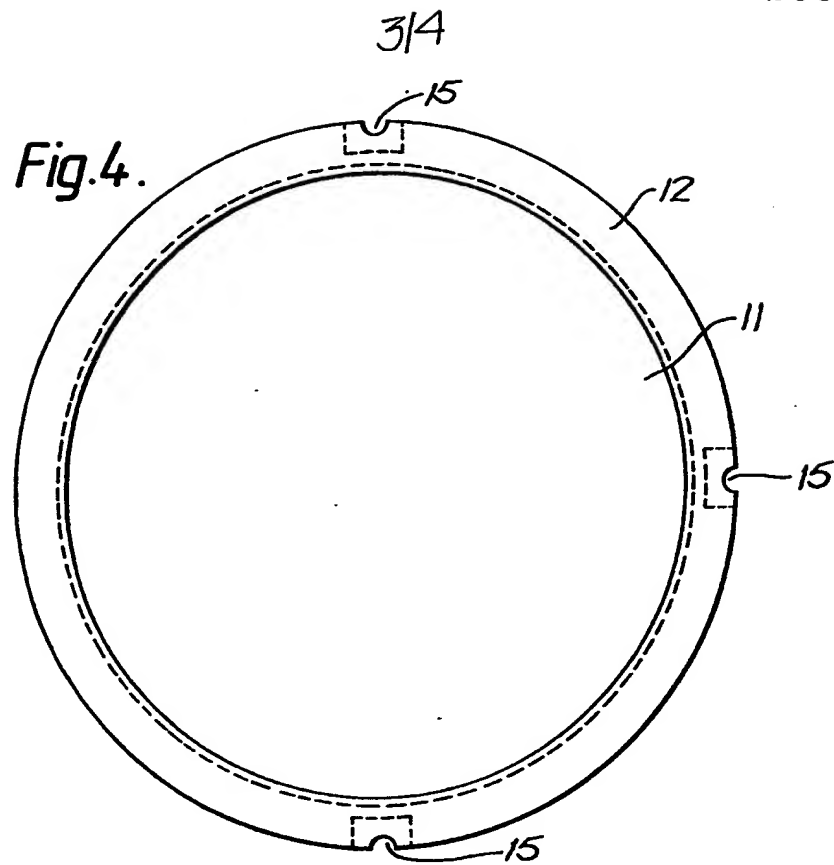
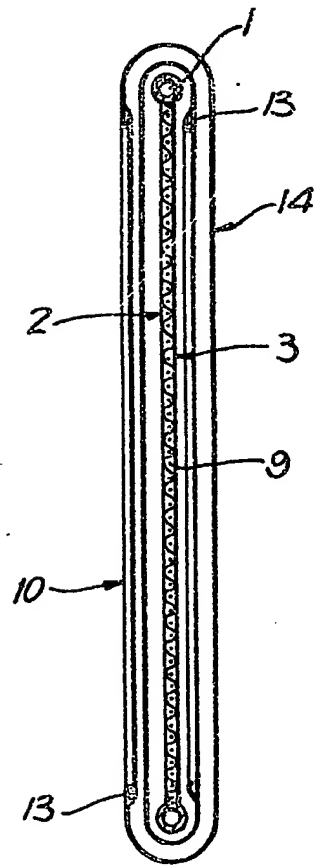


Fig. 6.



## SPECIFICATION

### Filtration apparatus

5 Leaf filtration apparatus is commonly used for the separation of solids from liquids. It consists of a vessel into which liquid to be filtered is introduced and which contains a plurality of filter leaves provided with means for removing filtrate from each leaf.

10 Often the filter leaves are mounted vertically.

A filter leaf suitable for vertical mounting has at least one filter face and comprises a peripheral frame surrounding the face and a plurality of fittings extending outwardly from the frame including at least one fitting by which the frame may be mounted with respect to a support and at least one fitting by which filtrate may be removed from within the frame. Generally both of the faces surrounded by the frame serve as filter faces but if desired one may be solid.

20 The or each filter face may be covered by a filter cloth. As a result of arranging for a pressure differential to exist across the filter cloth solids are accumulated on the outside of the filter cloth and filtrate enters the filter leaf and is removed from within the frame, and thus from within the leaf, and is taken out of the vessel.

It is generally necessary to provide support material within the frame for supporting any filter cloth that is across the or each filter face. The material must be permeable, to allow filtrate to pass through it and out of the frame, and is generally of wire mesh. The filter cloth is generally a textile.

Various fittings have to be provided in the frame both for mounting it with respect to a support and for removing filtrate from within the frame. The apparatus sometimes includes means for vibrating the filter leaves, so as to shake accumulated solids off the filter cloth, and so one or more of the fittings may serve to fix the frame to a vibratable support.

It is necessary that any filter cloth should define a tight seal with the entire frame, so as to prevent unfiltered liquid entering the leaf, and the presence of these outwardly extending fittings has made it a skilled and time consuming task to fit effectively a removable filter cloth.

To avoid this difficulty it is common instead to fix the cloth in some permanent manner, for instance by gluing, so as to obtain a permanent seal. However this has the disadvantage that when the cloth can no longer be used it is necessary to reject it.

According to the invention a filter leaf having at least one filter face comprises a peripheral frame surrounding the face and a plurality of fittings extending outwardly from the frame including at least one mounting fitting by which the frame may be mounted with respect to a support for the filter leaf and at least one filtrate fitting by which filtrate may be removed from within the frame, and all the outwardly extending fittings are removably fitted to the frame.

In use, the or each filter face is provided with a filter cloth that extends across that filter face and around the frame and is removably held against the frame or the opposite face of the leaf in such a man-

ner as to prevent passage of fluid into the frame except through the filter cloth. The part of the cloth that extends around the frame may be of the same material as extends across the filter face, and may thus permit filtration, or may be of a less permeable or impermeable material.

In order to fit such a filter cloth the removable outwardly extending fittings are removed, the cloth is positioned across the filter face and around the frame, and the fittings are replaced. Generally it will be necessary for apertures to be made in the cloth to permit the fittings to be removably fitted through the cloth into the frame. These apertures may be pre-formed or may be formed during the replacement of the fittings.

Any means for removably holding the filter cloth against the frame or one face of the leaf may be used provided it ensures that fluid can only enter the leaf through the filter cloth.

85 In one system the filter cloth is in the form of a bag that extends across one filter face, around part of the periphery of the frame, and across the other filter face and is provided with securing means for removably holding it around the remainder of the periphery of the frame. For example the bag may include drawstrings by which its open end may be sealed, so that each face of the bag can be considered to be removably holding the opposite face of the bag in position.

95 Instead of enclosing the leaf within a filter bag it is possible to provide a filter cloth that extends across one filter face only. Such a cloth may have a filter area, that is to be positioned over the filter face, surrounded by a cuff and means for securing the cuff to or adjacent the opposite face of the filter leaf. Generally the cuff is secured adjacent this opposite face, for instance by applying radial tension to the cuff over the opposite face. This may be done by, for instance, providing one or more drawstrings around the edge of the cuff and pulling them tight. The cuff may be formed of the same material as the filter area or may be formed of different material which may be less permeable or impermeable. When, as is usual, both faces of the filter leaf serve as filter faces then two of these cloths may be provided, one for each face.

It is generally necessary to provide permeable support material within the frame to support the filter cloth. This support material may be of conventional steel or other metal mesh. Preferably however it is of plastics drainage material. When both faces of the filter leaf are serving as filter faces it is preferred that a single layer of permeable plastics material shall support both filter cloths.

120 This plastics material may be formed of any flexible material that is inert to the liquids to be filtered and which is sufficiently permeable to allow passage of filtrate through the filter leaf and to the outlet from the leaf. It may be a self-supporting foam but preferably is a self-supporting woven or welded mesh, for example mesh formed of fused ribs of filaments bonded (e.g. by fusion) across one another. Typically each filament or rib may be 0.5 to 3 mm thick with the result that the mesh may be 1 to 6 mm thick, and such filaments or ribs may be, for example, 3 to 20,

typically around 8, mm apart. One such coarse mesh is sold under the Trade Name "Netlon".

As a result of using plastics material for the support, the support can be designed to be more flexible than conventional metal supports, while still giving proper support to the filter cloth, and as a result of this flexibility vibration of the frame will result in larger amplitude vibrations of the support, and hence of the cloth. As a result less vibration of the frame is required to dislodge filter solids. Also there is less risk of fatigue failure of the support material than previously.

A further advantage of the use of flexible plastics material as the support is that it reduces the weight of the leaf so that handling and fitting of the leaves into the filtration apparatus is much easier. The frame may also be made of plastics material.

Filter apparatus according to the invention may comprise a conventional filtration vessel fitted with the described filter leaves. Thus the apparatus may comprise a vessel, means for supporting a plurality of filter leaves in the vessel, the leaves described above mounted vertically on the support means by the said mounting fittings, an inlet to the vessel for liquid to be filtered, means for withdrawing filtrate from the filtrate fittings and out of the vessel and means for applying a pressure difference across each filter face. The filtrate fittings may serve also as mounting fittings by which the frame may be mounted on the support means. Generally there are means for vibrating the support means, and thus the filter leaves. Often the liquid inlet pressure to the vessel is atmospheric with the filtrate outlet pressure being lower, so as to create suction across the filter cloth, but alternatively the outlet may be atmospheric and the inlet above atmospheric.

The invention not only includes a filter leaf comprising a frame and the defined removable fittings, optionally in combination with the described permeable plastics support material and optionally in combination with suitable filter cloth, as described above, and filtration apparatus including such filter leaves, but also includes the plastics support material itself and filter cloth provided with the described cuff and means for securing the cuff to or adjacent the reverse face.

These two features, namely the filter cloth and the permeable support material, may be used individually or together in other constructions of filter leaf. For instance the permeable plastics material may be used in place of metal mesh in any conventional filter leaf construction and the filter cloth provided with the cuff and means for securing it to or adjacent the opposite side of the filter leaf may be used in horizontal filter leaves, for instance leaves having a single filter face with the opposite face being impermeable and being provided with a drainage outlet.

Vertical filter leaves according to the invention are illustrated in the accompanying drawings in which:—

Figure 1 is a side view of a leaf.

Figure 2 is a section on the line II-II.

Figure 3 is a section on the line III-III.

Fig. 4 and 5 are side views of the two sides of such

a filter with the filter cloth in position and

Figure 6 is a diagrammatic vertical section through a filter with the cloth in position.

The filter leaf comprises a tubular frame defining two opposed faces 2 and 3. In the leaf illustrated both faces are to serve as filter faces.

The frame is supported by a side support bolt 4 and a drainage nozzle 5 to conventional support apparatus and is mounted for vibration from a conventional vibrator plate 6 by a bolt 7. A plurality of equally spaced drain holes 8 are provided in the inner surface of the lower half of the frame to permit liquid to drain into it and to be removed through the outlet 5. Plastic supporting mesh 9 extends across the area of the frame and is held in position by clips 20. The mesh 9 is generally of substantially the same thickness as the frame. For clarity only a few of the holes 8 and clips 20 are illustrated in Figure 1.

Fittings 4, 5 and 7 are detachable from the frame 1, for instance by being unthreaded. A filter cloth 10 having a filtration area 11 surrounded by a cuff 12 can then be fitted over the filtration face 2 with the cuff extending around the frame and down the reverse face 3. Drawstrings 13 are provided in the edge of the cuff and, upon being drawn tight, they hold the filter cloth 10 tightly in position over the filter face 2.

A second filter cloth 14 of generally similar construction may then be fitted in similar manner over filter face 3, with its cuff being drawn tight over reverse face 2. The filter cloths 10 and 14 are provided with openings 15 to permit the fittings 4, 5 and 7 to be screwed into the frame after the cloths have been positioned, a liquid tight seal between these openings and the fittings being achieved by the provision of saddle washers 16.

#### CLAIMS

1. A filter leaf having at least one filter face and which comprises a peripheral frame surrounding the face and a plurality of fittings extending outwardly from the frame including at least one mounting fitting by which the frame may be mounted with respect to a support for the filter leaf and at least one filtrate fitting by which filtrate may be removed from within the frame, and in which all the outwardly extending fittings are removably fitted to the frame.

2. A filter leaf according to claim 1 in which there is permeable support material within the frame to support filter cloth across the filter face or faces.

3. A filter leaf according to claim 2 in which the permeable support material is a self-supporting woven or welded plastics mesh material.

4. A filter leaf according to any preceding claim in which the or each filter face is provided with a filter cloth that extends across that filter face and around the frame and is removably held against the frame or the opposite face of the leaf in such a manner as to prevent passage of fluid into the frame except through the filter cloth.

5. A filter leaf according to claim 4 in which both faces of the leaf are filter faces.

6. A filter leaf according to claim 5 in which the filter cloth is in the form of a bag that extends across one filter face, around part of the periphery of the frame, and across the other filter face and is pro-

vid d with securing means f r removably holding it around th remainder of the periphery of th frame.

7. A filter leaf according to claim 4 or claim 5 in which th filter cl th has a filter ar a position d over  
5 a filter face and surrounded by a cuff that is secured to or adjacent the opposite face by securing means.

8. A filter leaf according to claim 6 or claim 7 in which the securing means include drawstrings.

9. Filter apparatus comprising a vessel, means  
10 for supporting a plurality of filter leaves in the vessel, a plurality of filter leaves according to any preceding claim mounted vertically on the support means by the said mounting fittings, an inlet to the vessel for liquid to be filtered, means for withdrawing filtrate  
15 from the filtrate fittings and out of the vessel, and means for applying a pressure differential across each filter face.

10. Filter apparatus according to claim 9 including means for vibrating the support means.

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New claims or amendments to claims filed on 30th June 1982

Superseded claim 1-10.

- 25 1. Filter apparatus comprising a vessel that includes a support by which filter leaves may be mounted, an inlet for supplying liquid to be filtered, an outlet for removal of filtrate, means for applying a pressure differential across the or each filter face of  
30 each filter leaf, and a plurality of filter leaves, and in which each leaf comprises a peripheral frame that surrounds the filter face or faces and is secured to the support by at least one removable mounting fitting extending outwardly from the frame and is connected to the outlet by at least one removable outlet  
35 fitting extending outwardly from the frame, all the outwardly extending fittings on the frame being removably fitted to the frame.

2. Apparatus according to claim 1 in which the or  
40 each filter face on each filter is provided with a filter cloth that extends across the filter face and around the frame to the opposite face of the leaf and in which there are securing means by which the cloth is removably held against the opposite face of the leaf  
45 in such a manner as to prevent passage of fluid into the frame except through the filter cloth.

3. Apparatus according to claim 2 in which the filter cloth has a filter area positioned over a filter face and surrounded by a cuff that is secured to or adjacent the opposite face by the securing means.  
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4. Apparatus according to claim 2 in which the filter cloth is in the form of a bag that extends across one filter face, around part of the periphery of the frame, and across the other filter face, and the securing means removably hold it around the remainder of the periphery of the frame.

5. Apparatus according to any of claims 2 to 4 in which the securing means include draw strings.

6. Apparatus according to any preceding claim in  
60 which ther is permeable support mat rial within th fram t support filter cloth across the filter face r faces.

7. Apparatus acc rding t claim 6 in which th perm able support material is a self-supporting  
65 wov n or welded plastics m sh mat rial.

8. Apparatus acc rding to any preceding claim in which the fittings are removably screwed to th frame and washers are provided to give a liquid-tight seal between each fitting and the frame.

- 70 9. Apparatus according to any preceding claim in which the support includes a vibrator plate and means for vibrating the plate.

10. Apparatus according to any preceding claim in which each frame is substantially circular.

- 75 11. Apparatus according to any preceding claim in which both faces of each leaf are filter faces.

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